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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/736,237	12/15/2003	Antonino Calabro	02CT39253415	3158

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EXAMINER	
COUGHLAN, PETER D	
ART UNIT	**PAPER NUMBER**
2129	

DATE MAILED: 05/12/2006

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary	Application No.	Applicant(s)
	10/736,237	CALABRO ET AL.
	Examiner	Art Unit
	Peter Coughlan	2129

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on *15 December 2003*.

2a)☐ This action is **FINAL**. 2b)☒ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *6-19* is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) *6-19* is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☒ The drawing(s) filed on *15 December 2003* is/are: a)☒ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

12)☒ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☒ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☒ Certified copies of the priority documents have been received in Application No. 10/736,237.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☒ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☐ Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08) Paper No(s)/Mail Date _____.
4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____ .
5) ☐ Notice of Informal Patent Application (PTO-152)
6) ☐ Other: _____.

Detailed Action

1. Claims 6-19 are pending in this application.

Specification Rejections

2. The specification is rejected to due to the following. Claims 6, 9, 11, 16. uses the term " 2^n (i = 1 + 2^n (j – 1)) ". This could have a number of meanings but none are addressed or explained in the specification.

The specification is rejected to due to the following. Claims 8, 15 uses the formulas "cos ((2π (j – 1) int [(h – 1)/ 2^n]) / 2^n) and sin ((2π (j – 1) int [(h – 1) / 2^n) 2^n)". The integer function is not well defined. Does the function behave by truncation or does it round up at times and at other times round down.

The specification is rejected to due to the following. Claims 7, 10, 13, 18 uses the phrase " the entanglement vector being equal to the non-null components of the superposition vector". This phrase is not mentioned in the specification and could have a number of meanings but none are addressed or explained in the specification.

Per the MPEP, section 608.01(l) the claim(s) is/are treated on its merits and a requirement made to amend the drawing and description to show the subject matter.

35 USC § 101

3. 35 U.S.C. 101 reads as follows:

> Whoever invents or discovers any new and useful process, machine, manufacture, or composition of matter, or any new and useful improvement thereof, may obtain a patent therefor, subject to the conditions and requirements of this title.

Claims 1-19 are rejected under 35 U.S.C. 101 for nonstatutory subject matter. The computer system must set forth a practical application of that § 101 judicial exception to produce a real-world result. Benson, 409 U.S. at 71-72, 175 USPQ at 676-77. The invention is ineligible because it has not been limited to a substantial practical application. A method for performing a Simon's or Shor's quantum algorithm has no real world practical application.

In determining whether the claim is for a "practical application," the focus is not on whether the steps taken to achieve a particular result are useful, tangible and concrete, but rather that the final result achieved by the claimed invention is "useful, tangible and concrete." If the claim is directed to a practical application of the § 101 judicial exception producing a result tied to the physical world that does not preempt the judicial exception, then the claim meets the statutory requirement of 35 U.S.C. § 101.

The phrase 'performing a superposition operation according to the Shor's algorithm over a set of input vectors, and generating a corresponding superposition vector' is nothing more than an algorithm. There has to be a practical application for such an algorithm.

The invention must be for a practical application and either:

1) specify transforming (physical thing) or

2) have the FINAL RESULT (not the steps) achieve or produce a

useful (specific, substantial, AND credible),

concrete (substantially repeatable/ non-unpredictable), AND

tangible (real world/ non-abstract) result.

A claim that is so broad that it reads on both statutory and non-statutory subject matter, must be amended, <u>and if the specification discloses a practical application but the claim is broader than the disclosure such that it does not require the practical application, then the claim must be amended</u>.

An algorithm that serves no purpose is not statutory.

A second rejection is the claimed subject material seems to be in contradiction to other sources with the cohesion between the quantum world and the classical computer. For example in claims 6, 9, 11 and 16 which state 'calculating as a function of the n qubits a value ($1 / 2^{n/2}$) of non-null components of the superposition vector'. In Michael A. Niesen's 'Rules for a Complex Quantum World', (Scientific American 11/2002), states that the amount of classical information which can be stored on a qubit, is infinite.

(**Niesen,** p71, C1:25-35) Since the number of data which can be stored on a qubit, is infinite implies that the 'superposition vector' of applicant must be infinite in length to 'contain it'. This leads to the entanglement vector being infinite in length as well. A practical application is not capable of processing infinite vectors.

A third rejection is the lack of utility of the invention based on the nature of quantum computing and the duration of coherence. If a qubit is spinning such a way that there is a probability of 75% a value of '1' and a probability of 25% a value of '0' would result. The final state is determined when the qubit is 'looked at'. And the fact that the value of '1' is three times more likely to appear than the value of '0'. So quantum computing is based on probability. Along with that is after the spinning quantum is 'looked at', decoherence occurs and further quantum calculation is impossible.

A forth rejection regarding to claim 1 states a method of performing a 'Simon's' or 'Shor's' algorithm. Which algorithm is it? Is it 'Simon's' or 'Shor's'?

A fifth rejection regarding to claim 1 is the generation of the superposition vector (P). If the calculating of the indices of the 2^n non null components is represented by f(P) then claim 1 states P = f(---P) is a circular argument.

Claim Rejections - 35 USC § 103

4. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

Claims 6, 7, 9-14, 16-19 are rejected under 35 U.S.C. 103(a) as being unpatentable over Ulyanov et al in view of Cleve (U. S. Patent Publication 20040024750, referred to as **Ulyanov**; U. S. Patent Publication 20030005010, referred to as **Cleve**)

Claims 6, 9, 11, 16.

Ulyanov teaches performing a superposition operation according to the Shor's quantum algorithm over a set of input vectors, and generating a corresponding superposition vector, the performing comprising (**Ulyanov,** ¶0512; 'Input vectors' and 'superposition vector' of applicant is equivalent to "set of vectors' and 'linear superposition of cells' of Ulyanov.) calculating as a function of the n qubits a value ($1/2^{n/2}$) of non-null components of the superposition vector. (**Ulyanov,** p11, table 3.1:under 1D Uniform. ; This p(y) of Ulyanov is equivalent to

¶0144 and formula (6B) of applicant. The exponent of $^{n/2}$ of applicant is equivalent to "Δ" of Ulyanov. (note 'n' is a constant.))

Ulyanov does not teach calculating indices (i) of the 2^n non-null components of the superposition vector as an arithmetic succession, a seed of which is 1 and a difference of which is 2^n ($i = 1 + 2^n (j - 1)$).

Cleve teaches calculating indices (i) of the 2^n non-null components of the superposition vector as an arithmetic succession, a seed of which is 1 and a difference of which is 2^n ($i = 1 + 2^n (j - 1)$) (**Cleve,** '2^n non-null components' of applicant is equivalent to 'contains 2^n gates' of Cleve. There is a one to one correlation between gates and components.) It would have been obvious to a person having ordinary skill in the art at the time of applicant's invention to modify the teachings of Ulyanov by having the values of 2n components generated as taught by Cleve to calculating indices (i) of the 2^n non-null components of the superposition vector as an arithmetic succession, a seed of which is 1 and a difference of which is 2^n ($i = 1 + 2^n (j - 1)$).

For the purpose of carrying out the superposition operation in a comparably very fast manner because it generates the superposition vector by identifying only the non-null components thereof by calculating, as a function of the number n of qubits

Ulyanov teaches performing an entanglement operation on the superposition vector, and generating a corresponding entanglement vector (**Ulyanov,** ¶0521; 'Entanglement operation' of applicant is equivalent to 'entanglement operator' of Ulyanov.); and performing an interference operation on the entanglement vector,

and generating a corresponding output vector. (**Ulyanov,** ¶0521; 'Interference operation' of applicant is equivalent to 'interference operator' of Ulyanov.)

Claims 7, 10, 13, 18

Ulyanov teaches calculating indices (k) of the 2^n non-null components of the entanglement vector, summing to each term of the arithmetic succession a relative number corresponding to the value of the function (f(j)) calculated based upon a position (j) of the term in the succession ($k = f(j)+1+2^n (j-1)$) (**Ulyanov,** ¶0574; Ulyanov illustrates the generation of entanglement operator based on initial position.); and a value of the non-null components of the entanglement vector being equal to the non-null components of the superposition vector. (**Ulyanov,** ¶0296; 'Equal' of applicant is equivalent to 'applied' of Ulyanov. Note—Applicant never states in the specification that the entanglement vector equals the superposition vector.)

Claims 12, 17.

Ulyanov teaches a first memory buffer for storing the value ($1/2^{n/2}$) and the indices (i). (**Ulyanov,** ¶0317; 'Memory buffer' of applicant is equivalent to 'register' of Ulyanov.)

Claims 14, 19

Ulyanov teaches a second memory buffer for storing the indices (k) of the 2^n non-null components of the entanglement vector. (**Ulyanov,** ¶0318; 'Memory buffer' of applicant is equivalent to 'register' of Ulyanov.)

Conclusion

5. The prior art of record and not relied upon is considered pertinent to the applicant's disclosure.

-U. S. Patent 6578018: Ulyanov

-U. S. Patent Publication 20040208638: Jansen

-U. S. Patent Publication 20020106084: Azuma

-'Beyond Bits: The Future of Quantum Information Processing': Steane and Rieffel

-'Notes on Quantum Information Theory': Lomonaco

-'Dynamic and Information Analysis of Quantum Gates for Simulation of Quantum Aalgorithms on Classical Computers'; Ulyanov

-'On Quantum computing with Macroscope Josephon Qubits': Han, Jonker

-'Quantum computing: an introduction': Hey

-'On the power of quantum computation': Simon

-'algorithms for Quantum Computation: Discrete Logarithms and Factoring': Shor

-'Introduction to Quantum Algorithms': Shor

-'Polynomial-time Algorithms for Prime Factorization and Discrete Logarithms on a Quantum Computer': Shor

-'Quantum computation and Shor's algorithm': Ekert, Jozsa

6. Claims 6, 7, 9-14, 16-19 are rejected.

Correspondence Information

7. Any inquiry concerning this information or related to the subject disclosure should be directed to the Examiner Peter Coughlan, whose telephone number is (571) 272-5990. The Examiner can be reached on Monday through Friday from 7:15 a.m. to 3:45 p.m.

If attempts to reach the Examiner by telephone are unsuccessful, the Examiner's supervisor David Vincent can be reached at (571) 272-3687. Any response to this office action should be mailed to:

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Peter Coughlan

5/3/2006

P.E.